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Economics Department

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28TH ANNUAL McGRAW-HILL SURVEY OF BUSINESS' PLANS FOR RESEARCH AND DEVELOPMENT EXPENDITURES, 1983-86

After surging for several years, the pace of research and development (R&D) spending by U.S. companies is slowing down.

In 1980 and 1981, R&D outlays galloped ahead by more than 16% a year. The advance slowed to 8.4% in 1982. And in 1983 it's projected to remain at about last year's pace, with companies planning to boost R&D spending 8.2% to $60.9 billion (Table I).

These are highlights of McGraw-Hill's annual survey of business' R&D plans, conducted in March and April. Survey results are based on responses from more than 300 companies, but figures in this report are adjusted to represent spending by all U.S.firms.

The survey suggests that, like other types of corporate expenditures, R&D budgets have fallen victim to recession. For not only is R&D's rate of advance slowing down, but R&D plans formulated last year got scaled back substantially. In last year's survey, companies projected a 17% hike in 1982 R&D spending. The increase is now estimated at half the rate planned initially.

Moreover, last year's survey found that companies expected to boost R&D budgets some 12% a year through 1985. The forecast now puts the increase at 7% annually during the next few years (Table I).

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R&D Still Remains a Top Priority

The gross numbers, however, probably put too sorry a face on the survey results. Key reason is that inflation is way down from two years ago, and it's down from last year too. So once the data are adjusted for smaller price increases the R&D slowdown doesn't seem quite as bad. In fact, as shown in Chart I, 1983 growth in "real" (inflation-adjusted) R&D outlays might top the 1982 rate. At the same time, however, this year's projected real advance of 3%-4% will be much lower than the 6%-7%

Chart I. R&D's Torrid Advance Slows Down

	% Change		
	R&D Spending	Inflation	"Real" R&D Spending
1980	16.4%	9.3%	6.5%
1981	16.5	9.4	6.5
1982	8.4	6.0	2.3
1983 (F)	8.2	4-5	3-4

F = Forecast

gains scored in 1980 and 1981.

With companies struggling against weak markets, declining cash flow, and high interest rates, it may come as no surprise that managers decided to trim ambitious R&D plans this year and last. Yet when compared to other areas of corporate spending, R&D has come out of the recession wringer relatively intact. For example, Chart II shows that while companies raised R&D outlays 8% last year, they reduced outlays

on capital goods. Since both R&D and capital spending provide long-term benefits, this allocation of funds suggests that firms expect a greater return on investment in R&D than in fixed capital.

The relative shift to R&D is projected to continue this year, as business plans another cut in capital spending coupled with a hike in R&D. Thus R&D as a percentage of capital spending is projected to rise from 17.8% in 1982 to 19.5% in 1983 (Table V).

Chart II. Relatively Speaking, R&D Growth is Strong

	% Change		
	R&D Spending	Plant & Equipment Investment	Gross National Product
1980	16.4%	9.6%	8.9%
1981	16.5	8.7	11.6
1982	8.4	-1.2	4.1
1983(F)	8.2	-1.3	6.3

F = Forecast

As another example of the relative importance companies are putting on R&D, consider that wages and salaries in the private sector last year rose at only half the rate of R&D spending. Magazine advertising outlays rose at about three-fourths the R&D rate. In short, at a time when business expenditures of all sorts are undergoing close scrutiny by top management, R&D budgets have emerged comparatively unscathed.

It looks, moreover, like this relative emphasis on R&D will continue. For despite the paring down of longer-term plans (compared to last year's survey), R&D is still projected to rise faster than capital spending. Thus the ratio of R&D to capital outlays is projected to

increase a half percentage point by 1986.

Will R&D Continue to Roll?

Whether R&D rises faster than capital spending may not be very important, however, if both are rising slowly. But at least with R&D, the survey's longer-term projections might be taken as a lower bound.

For one thing, plans through 1986 were formulated during a recession when all budgets were feeling the ax. Thus, if the recovery now underway gathers steam, some canceled R&D projects could get reinstated.

Furthermore, recent history suggests that R&D spending could advance faster than current plans envision. The evidence to support this statement is presented in Chart III. From 1975 to 1982,

Chart III. U.S. Returned to R&D in Mid-70s

	Average Annual % Change		
	R&D Spending	Inflation	"Real" R&D Spending
1953-68	11.0%	2.3%	8.5%
1968-75	4.8	6.2	-1.3
1975-82	12.8	7.4	5.0

R&D spending rolled ahead at a 5% annual clip, after taking out inflation. If business maintains that rate of increase in the future, and if inflation stays in the 5% range, R&D outlays (including inflation) would grow some 10% a year on average rather than 7%.

But is it realistic to think U.S. companies will keep up the R&D commitment they began to make in the mid-1970s? After all, as Chart III shows, R&D spending grew very slowly from 1968 to 1975. In fact, real spending fell during that period at an annual average rate of 1.3%. Perhaps not by coincidence, it was also during that period when American business began to lose its leadership role in technology and in world markets.

This slippage, however, apparently produced at least one positive side effect: It galvanized many U.S. businesses into reinvigorating R&D programs.

For example, from 1967 to 1975 foreign auto makers increased their share of the U.S. market from 9% to 18%. U.S. car makers, meanwhile, were hiking their R&D budgets 7.5% a year on average. Since then, however, U.S. auto companies have boosted R&D budgets an average of 11.5% a year. And even though U.S. motor vehicle sales declined some 4% last year, producers still raised R&D budgets a bit. More dramatically, despite the fact that 1982 sales were off 6% from 1977, auto industry R&D spending between 1977 and 1982 zoomed 48%.

Besides auto makers, manufacturers in general have also been devoting more and more resources to R&D, as measured by the ratio of R&D to sales. This ratio declined steadily from 1967 to 1974 (Table VIII), bottoming out at 2.17%. It then rose and fell again in the late 1970s. But by 1982 it reached its highest levels since the mid-1960s. While this rise in part reflects weak sales (the denominator of the ratio), it also shows that as sales slumped firms hung on to their R&D plans.

Thus, judging from the relatively generous allocation of corporate funds to R&D in recent years, it seems that U.S. firms are extending their planning horizons. In other words, the era in which American business was preoccupied with short-term results may be giving way to a period in which investment for the long haul comes back in vogue.

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NOTE: The other manufacturing category in the tables includes lumber, wood products and furniture, tobacco, printing and publishing, leather, jewelry, toys, and transportation equipment other than autos, trucks and parts and aerospace. The nonmanufacturing category includes mining, construction, electric and gas utilities, commercial enterprises and transportation.

SOURCES: National Science Foundation, McGraw-Hill Publications Company Economics Department

TABLE I

RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of Dollars)

INDUSTRY	1981* Estimated	1982 Estimated	----Planned---- 1983	1986	1982-83 % Change	1983-86 % Change
Iron & Steel	$ 434	$ 545	$ 556	$ 612	2.0%	10.1%
Nonferrous Metals	349	350	315	331	-10.0	5.1
Electrical Machinery	10,466	10,941	12,750	15,326	16.5	20.2
Machinery	6,800	7,284	7,874	9,482	8.1	20.4
Autos, Trucks & Parts	4,929	4,974	5,399	6,407	8.5	18.7
Aerospace	11,702	13,491	13,506	16,285	0.1	20.6
Fabricated Metals	638	552	507	552	-8.2	8.9
Instruments	3,685	4,267	4,741	6,964	11.1	46.9
Stone, Clay & Glass	455	486	508	676	4.5	33.1
Chemicals	5,325	6,091	6,826	8,655	12.1	26.8
Paper & Pulp	557	586	597	708	1.9	18.6
Rubber	684	754	818	947	8.5	15.8
Petroleum	2,009	2,237	2,486	2,924	11.1	17.6
Food & Beverages	719	844	895	1,012	6.0	13.1
Textile Mill Products & Apparel	124	96	97	111	1.0	14.4
Other Manufacturing	855	896	947	1,162	5.7	22.7
ALL MANUFACTURING	49,731	59,394	58,822	72,154	8.1	22.7
ALL NONMANUFACTURING	2,099	1,813	1,972	2,606	8.8	32.2
ALL INDUSTRIES	51,830	56,207	60,794	74,760	8.2	23.0

* Based on preliminary National Science Foundation data.

TABLE II

NEW PRODUCTS SALES - 1986

INDUSTRY	Percent of 1986 Sales	Billions of Dollars
Iron & Steel	21.2%	$16.49
Nonferrous Metals	9.2	5.77
Electrical Machinery	22.4	45.55
Machinery	26.1	67.54
Autos, Trucks & Parts	24.7	40.51
Aerospace	34.4	34.32
Fabricated Metals	18.7	24.45
Instruments	42.5	29.47
Stone, Clay & Glass	4.3	2.77
TOTAL DURABLES	28.4	372.71
Chemicals	39.9	98.36
Paper & Pulp	7.1	8.20
Rubber	9.7	5.43
Petroleum	6.4	16.62
Food & Beverages	15.0	59.09
Textile Mill Products	33.9	24.86
TOTAL NONDURABLES	26.6	371.33
ALL MANUFACTURING	31.9	863.96

TABLE III

PERCENT OF RESEARCH & DEVELOPMENT EXPENDITURES GOING FOR
NEW PRODUCTS, NEW PROCESSES & IMPROVEMENT OF EXISTING PRODUCTS

	In 1982			In 1983			1984-86 Average		
INDUSTRY	New Products	New Processes	Improving Existing Products	New Products	New Processes	Improving Existing Products	New Products	New Processes	Improving Existing Products
Iron & Steel	43%	13%	44%	43%	13%	44%	43%	13%	44%
Nonferrous Metals	22	26	52	23	20	57	29	19	52
Electrical Machinery	37	20	43	36	20	44	37	20	43
Machinery	35	27	38	33	27	39	36	26	38
Autos, Trucks & Parts	23	12	66	50	18	32	50	18	32
Aerospace	47	16	37	37	34	29	37	32	31
Fabricated Metals	32	22	46	32	23	45	32	22	45
Instruments	76	11	14	76	11	13	77	11	12
Stone, Clay & Glass	29	23	47	31	18	51	15	50	34
Chemicals	27	21	52	28	21	52	28	21	52
Paper & Pulp	21	55	23	23	53	23	21	57	22
Rubber	29	21	50	25	24	51	26	24	51
Petroleum	23	57	20	23	57	20	28	33	38
Food & Beverages	19	21	60	25	16	59	18	16	67
Textile Mill Products & Apparel	37	25	39	36	26	37	39	25	35
Other Manufacturing	46	20	34	46	22	32	49	25	26
ALL MANUFACTURING	38	21	41	38	25	36	39	24	38

TABLE IV

RESEARCH & DEVELOPMENT AS A PERCENT OF SALES

INDUSTRY	1982	1983	1986
Iron & Steel	1.18%	1.06%	0.79%
Nonferrous Metals	0.76	0.66	0.53
Electrical Machinery	7.92	8.59	7.54
Machinery	3.96	4.11	3.66
Autos, Trucks & Parts	4.49	4.53	3.91
Aerospace	20.90	18.34	16.32
Fabricated Metals	0.48	0.46	0.42
Instruments	9.14	9.20	7.16
Stone, Clay & Glass	1.07	1.03	0.74
Chemicals	3.60	3.73	3.5
Paper & Pulp	0.75	0.68	0.61
Rubber	1.77	1.81	1.69
Petroleum	1.11	1.23	1.13
Food & Beverages	0.31	0.31	0.26
Textiles	0.19	0.18	0.15
Other Manufacturing	0.32	0.29	0.27
ALL MANUFACTURING	2.88	2.90	2.66

TABLE V

RESEARCH & DEVELOPMENT AS A PERCENT OF CAPITAL SPENDING

INDUSTRY	1982	1983	1986
Iron & Steel	15.71%	21.47%	14.17%
Nonferrous Metals	12.92	17.80	13.03
Electrical Machinery	103.02	111.74	90.74
Machinery	56.51	64.91	48.43
Autos, Trucks & Parts	100.68	62.85	55.81
Aerospace	223.36	199.79	221.13
Fabricated Metals	21.31	18.85	20.00
Instruments	181.57	165.19	116.53
Stone, Clay & Glass	18.62	18.41	12.90
Chemicals	45.90	56.27	58.13
Paper & Pulp	9.82	9.42	12.06
Rubber	44.09	40.70	38.34
Petroleum	8.38	9.94	9.88
Food & Beverages	10.90	11.92	12.06
Textiles	7.22	7.58	8.47
ALL MANUFACTURING	45.45	49.96	48.53
ALL NONMANUFACTURING	0.92	1.01	1.15
ALL INDUSTRIES	17.76	19.47	19.92

TABLE VI

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of Dollars)

INDUSTRY	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Primary Metals	$ 62	$ 69	$ 74	$ 90	$108	$131	$152	$177	$177	$171	$183
Iron & Steel	42	44	46	55	64	80	84	102	98	97	106
Nonferrous Metals	20	25	28	35	44	51	68	75	79	74	77
Machinery	330	358	455	543	669	781	930	949	901	914	958
Electrical Machinery & Communications	817	904	983	1,516	1,804	1,969	2,329	2,532	2,483	2,639	2,866
Radio & TV Receiving Equipment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Commun. Equip. & Elect. Components	74	141	200	575	748	868	1,162	1,324	1,404	1,591	1,773
Other Electrical Equipment	743*	763*	783*	941*	1,056*	1,101*	1,167*	1,208*	1,079*	1,048*	1,093*
Aerospace	829	999	1,285	2,138	2,574	2,609	3,090	3,514	3,829	4,042	4,712
Autos & Other Transp. Equipment	495	531	561	688	707	856	866	884	936	999	1,090
Fabricated Metal Products	52	55	65	116	135	162	138	145	136	146	153
Professional & Scientific Instrument	178	195	176	200	249	294	309	329	297	309	284
Scientific & Mechanical Measures	86	94	85	97	139	156	159	160	119	101	70
Optical, Surgical & Photo	92	101	91	103	110	138	150	169	178	208	214
Stone, Clay & Glass	40	45	46	60	69	75	81	88	88	96	100
Lumber & Furniture	10	10	10	10	14	12	12	10	10	10	11
Chemicals	374	407	445	641	705	792	891	980	1,101	1,175	1,239
Industrial Chemicals	269	289	315	460	503	553	600	666	706	738	809
Drugs & Medicines	40	50	60	94	104	128	154	162	180	195	216
Other Chemicals	65	68	70	87	98	111	137	152	215	242	214
Paper	29	33	32	36	35	42	49	56	59	65	69
Rubber	54	65	79	105	107	89	115	121	138	141	156
Petroleum	149	167	172	182	211	246	278	296	299	310	317
Food & Beverages	54	61	70	64	74	83	91	104	125	121	130
Textiles & Apparel	10	12	12	12	15	26	30	38	30	28	30
Other Manufacturing	53e	58e	64e	74e	93	105	118	119	105	65	54
ALL MANUFACTURING	3,536e	3,969e	4,529e	6,475e	7,569	8,272	9,479	10,341	10,714	11,230	12,354
ALL NONMANUFACTURING	94e	101e	111e	130e	162	117	139	168	194	234	276
ALL INDUSTRY	3,630	4,070	4,640	6,605	7,731	8,389	9,618	10,509	10,908	11,464	12,630

* - Includes Radio & TV
NA - Not Available
e - Estimated
SOURCE: National Science Foundation.

TABLE VI (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of Dollars)

INDUSTRY	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Primary Metals	$195	$213	$232	$242	$251	$257	$275	$272	$277	$307	$358
Iron & Steel	116	128	139	135	135	136	149	144	147	163	181
Nonferrous Metals	79	85	93	107	115	121	126	128	130	145	177
Machinery	1,015	1,065	1,217	1,326	1,483	1,546	1,729	1,860	2,158	2,549	2,985
Electrical Machinery & Communications	2,972	3,200	3,626	3,867	4,083	4,347	4,220	4,389	4,680	4,902	5,011
Radio & TV Receiving Equipment	NA	NA	47	45	55	57	70	64	48	49	51
Commun. Equip. & Elect. Components	1,872	1,989	2,249	2,425	2,520	2,670	2,604	2,739	2,913	3,019	2,913
Other Electrical Equipment	1,100*	1,211*	1,330	1,397	1,508	1,620	1,546	1,586	1,719	1,834	2,047
Aerospace	5,078	5,148	5,526	5,669	5,765	5,878	5,219	4,881	4,950	5,052	5,278
Autos & Other Transp. Equipment	1,182	1,230	1,344	1,354	1,499	1,568	1,591	1,768	2,010	2,477	2,476
Fabricated Metal Products	148	145	154	163	183	182	207	242	253	291	313
Professional & Scientific Instrument	331	403	468	542	663	742	744	746	838	961	1,075
Scientific & Mechanical Measure	74	80	87	104	118	123	131	133	163	186	221
Optical, Surgical & Photo	257	323	381	438	545	619	613	612	675	775	854
Stone, Clay & Glass	109	112	117	136	142	159	167	164	183	199	217
Lumber & Furniture	12	11	12	12	20	18	52	53	64	71	84
Chemicals	1,284	1,356	1,407	1,507	1,589	1,660	1,773	1,832	1,932	2,116	2,450
Industrial Chemicals	865	908	918	966	981	1,007	1,031	1,009	1,031	1,119	1,299
Drugs & Medicines	234	267	308	343	398	444	485	549	607	698	807
Other Chemicals	185	181	181	198	210	209	257	274	294	299	344
Paper	77	94	117	128	144	188	178	187	189	194	237
Rubber	158	162	168	182	223	261	276	289	377	426	469
Petroleum	393	397	371	371	437	467	515	505	468	498	622
Food & Beverages	144	157	164	183	184	199	230	240	259	269	298
Textiles & Apparel	32	38	51	57	58	60	58	59	61	64	69
Other Manufacturing	65	71	77	90	101	121	128	131	146	158	177
ALL MANUFACTURING	13,193	13,801	15,051	15,826	16,826	17,653	17,362	17,816	18,845	20,534	22,119
ALL NONMANUFACTURING	319	384	497	559	603	655	705	704	707	715	768
ALL INDUSTRY	13,512	14,185	15,548	16,385	17,429	18,308	18,067	18,320	19,552	21,249	22,887

NA - Not Available
* - Includes Radio & TV

TABLE ~~VII~~ VI (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of Dollars)

INDUSTRY	1975	1976	1977	1978	1979	1980
Primary Metals	$443	$506	$538	$560	$634	$728
Iron & Steel	215	256	284	314	375	443
Nonferrous Metals	228	250	254	246	259	285
Machinery	3,196	3,487	3,880	4,283	4,825	5,901
Electrical Machinery & Communications	5,105	5,636	5,886	6,507	7,824	9,175
Radio & TV Receiving Equipment	50	52	96	130	245	556
Commun. Equip. & Elect. Components	2,934	3,202	3,495	3,901	4,804	5,571
Other Electrical Equipment	2,121	2,382	2,295	2,476	2,775	3,048
Aerospace	5,713	6,339	7,033	7,536	8,041	9,198
Autos & Other Transp. Equipment	2,430	2,872	3,478	4,010	4,668	5,117
Fabricated Metal Products	324	358	386	384	455	550
Professional & Scientific Instrument	1,173	1,331	1,571	1,998	2,505	3,029
Scientific & Mechanical Measures	266	325	452	670	950	1,352
Optical, Surgical & Photo	907	1,007	1,119	1,328	1,555	1,677
Stone, Clay & Glass	233	263	287	324	356	406
Lumber & Furniture	88	107	123	126	139	148
Chemicals	2,727	3,017	3,202	3,580	4,038	4,636
Industrial Chemicals	1,391	1,524	1,668	1,798	1,962	2,197
Drugs & Medicines	981	1,091	1,117	1,308	1,517	1,777
Other Chemicals	354	401	417	474	559	662
Paper	249	313	333	387	445	495
Rubber	467	502	491	493	577	656
Petroleum	693	767	918	1,060	1,262	1,552
Food & Beverages	335	355	415	472	528	620
Textiles & Apparel	70	82	83	89	101	115
Other Manufacturing	205	217	243	266	288	364
ALL MANUFACTURING	23,452	26,152	28,867	32,075	36,686	42,690
ALL NONMANUFACTURING	735	845	958	1,229	1,540	1,815
ALL INDUSTRY	24,187	26,997	29,825	33,304	38,226	44,505

TABLE VII

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF CAPITAL INVESTMENT
(Percent)

INDUSTRY	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Primary Metals	4.53%	8.12%	8.31%	6.12%	4.82%	8.91%	13.10%	10.66%	15.39%	15.55%	13.66%
Iron & Steel	4.47	7.46	6.97	5.34	4.71	8.08	10.37	7.61	11.40	12.76	12.05
Nonferrous Metals	4.65	9.62	12.17	7.95	5.00	10.63	19.43	23.44	27.24	21.76	16.74
Machinery	41.77	51.88	56.17	50.28	52.27	84.89	91.18	78.43	81.17	72.54	77.26
Electrical Machinery	151.30	177.25	189.04	207.67	243.78	339.48	328.03	248.24	236.48	266.57	280.98
Aerospace	552.67	666.00	558.70	577.84	559.57	931.79	1030.00	1033.53	1276.33	1010.50	1079.91
Autos & Other Transportation Equipment	36.67	30.00	36.91	31.85	45.32	73.16	64.15	55.25	63.24	63.23	56.48
Fabricated Metals	11.82	11.96	12.50	18.13	19.57	30.57	22.26	24.17	26.15	24.75	22.17
Instruments	161.82	139.29	110.00	105.26	131.05	196.00	162.63	137.08	129.13	118.85	97.93
Stone, Clay & Glass	10.00	10.23	7.19	6.67	8.85	13.64	11.41	11.28	12.57	13.33	14.29
Chemicals	26.52	36.67	44.50	44.21	40.99	60.00	76.15	61.64	68.81	74.37	72.03
Paper	7.07	7.33	6.27	4.50	4.32	7.37	7.54	7.27	9.52	10.48	9.86
Rubber	22.50	32.50	32.92	31.82	32.42	40.45	41.07	35.59	38.33	37.11	40.00
Petroleum	5.19	5.74	5.62	5.26	5.48	9.04	10.00	10.24	10.07	10.06	10.23
Food & Beverages	5.24	5.98	7.14	5.61	6.07	7.55	7.46	7.70	8.33	8.34	8.67
ALL MANUFACTURING	28.45	33.08	36.23	39.65	43.25	63.73	68.89	63.21	68.99	70.06	71.53
ALL NONMANUFACTURING	.44	.48	.46	.46	.53	.40	.45	.52	.60	.66	.77
ALL INDUSTRY	10.81	12.28	12.68	14.76	16.07	19.89	21.48	21.61	22.81	22.36	23.72

TABLE VII (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF CAPITAL INVESTMENT
(Percent)

INDUSTRY	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Primary Metals	9.75%	9.26%	8.53%	8.04%	8.04%	8.89%	9.79%	11.88%	13.58%	12.04%	8.97%
Iron & Steel	8.06	8.05	8.08	7.11	6.72	7.43	9.14	11.34	13.74	13.04	9.33
Nonferrous Metals	14.11	11.97	9.21	9.64	10.36	11.42	10.68	12.55	13.40	11.15	8.63
Machinery	63.04	47.54	41.82	43.91	51.14	42.59	45.74	59.05	66.81	64.21	57.07
Electrical Machinery	254.02	189.35	144.46	123.55	129.21	132.94	120.92	144.85	165.37	140.06	130.16
Aerospace	1238.54	971.32	472.31	453.52	468.70	455.66	593.07	774.76	727.94	580.69	349.54
Autos & Other Transportation Equipment	44.27	38.32	39.07	42.45	49.64	44.67	42.20	60.76	53.89	51.71	46.28
Fabricated Metals	17.41	16.86	13.51	12.64	13.46	13.58	16.97	20.17	17.69	16.08	16.13
Instruments	114.14	80.60	65.00	75.28	90.82	81.54	85.52	93.25	96.32	83.57	90.34
Stone, Clay & Glass	13.46	13.02	10.35	14.78	15.96	14.20	15.75	17.45	13.66	12.59	13.23
Chemicals	61.14	48.09	42.00	48.93	56.75	55.15	52.46	56.02	57.16	49.91	37.87
Paper	8.46	8.79	8.86	8.59	11.34	11.60	10.23	14.50	12.95	9.75	8.20
Rubber	33.62	27.46	25.85	27.16	23.23	24.39	30.00	36.58	36.60	27.48	29.87
Petroleum	11.20	10.23	8.28	7.67	8.81	8.88	9.98	9.69	9.77	10.64	8.51
Food & Beverages	8.23	8.40	7.77	8.93	8.36	7.21	6.93	7.16	7.90	7.43	7.39
ALL MANUFACTURING	62.14	54.31	47.98	49.07	52.03	48.67	46.94	52.43	53.20	48.46	41.57
ALL NONMANUFACTURING	.79	.85	.98	1.09	1.07	1.04	1.03	.94	.83	.75	.74
ALL INDUSTRY	21.91	20.14	18.91	19.64	19.70	18.40	17.11	16.88	16.26	15.43	14.58

TABLE VII (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF CAPITAL INVESTMENT
(Percent)

INDUSTRY	1975	1976	1977	1978	1979	1980
Primary Metals	8.54%	10.10%	11.52%	12.10%	11.57%	11.38%
Iron & Steel	7.12	8.42	10.18	12.46	12.14	13.47
Nonferrous Metals	10.51	12.69	13.51	11.66	10.84	9.16
Machinery	64.44	63.06	58.88	59.40	45.87	50.91
Electrical Machinery	162.58	153.99	126.04	114.36	107.47	95.67
Aerospace	340.06	375.09	349.90	234.04	152.58	130.84
Autos & Other Transportation Equipment	57.31	61.11	59.76	55.54	56.24	56.48
Fabricated Metals	16.45	16.05	15.50	13.33	14.92	18.58
Instruments	110.66	117.79	116.37	125.66	142.33	132.85
Stone, Clay & Glass	14.04	14.06	12.81	10.45	9.04	10.63
Chemicals	35.74	37.16	39.34	42.32	37.46	36.79
Paper	8.36	10.06	9.25	9.70	8.02	7.28
Rubber	40.26	38.3[illegible]	29.76	23.48	26.59	37.92
Petroleum	7.23	7.12	7.23	7.60	7.79	7.50
Food & Beverages	8.33	7.40	8.11	7.91	7.98	8.39
ALL MANUFACTURING	42.70	43.62	41.70	40.23	37.18	36.86
ALL NONMANUFACTURING	.72	.76	.74	.81	.90	1.01
ALL INDUSTRY	15.34	15.75	15.06	14.40	14.13	15.05

TABLE VIII

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF SALES
(Percent)

INDUSTRY	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Primary Metals	.26%	.34%	.28%	.29%	.35%	.49%	.48%	.57%	.57%	.53%	.53%
Iron & Steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nonferrous Metals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Machinery	1.35	1.60	1.88	1.91	2.26	2.95	2.89	2.80	2.60	2.51	2.44
Electrical Machinery	4.45	5.60	5.51	7.77	9.01	10.26	10.34	10.75	9.68	9.27	9.60
Aerospace	6.84	8.87	11.17	16.80	17.31	19.90	20.27	24.12	25.43	24.24	26.38
Autos & Other Transp. Equipment	1.99	2.61	2.09	2.90	2.75	4.31	3.54	3.34	3.44	3.52	3.43
Fabricated Metals	.34	.37	.40	.54	.60	.76	.58	.61	.58	.58	.64
Instruments	4.74	5.45	4.53	4.68	5.40	6.30	6.18	6.70	6.29	6.81	6.92
Stone, Clay & Glass	.56	.62	.53	.67	.81	.76	.71	.79	.79	.82	.81
Chemicals	1.99	2.14	2.08	2.82	3.01	3.50	3.44	3.76	4.12	4.08	3.97
Paper	.35	.38	.32	.34	.32	.38	.40	.44	.44	.45	.46
Rubber	1.08	1.41	1.39	1.87	1.86	1.27	1.43	1.49	1.70	1.57	1.62
Petroleum	1.18	1.28	1.22	1.17	1.29	1.57	1.71	1.76	1.78	1.80	1.76
Food & Beverages	.12	.13	.14	.13	.14	.16	.16	.18	.18	.18	.19
Textiles	.08	.10	.09	.09	.10	.16	.17	.22	.23	.21	.20
ALL MANUFACTURING	1.26	1.49	1.57	2.06	2.31	2.53	2.61	2.79	2.89	2.81	2.94

NA - Not Available

TABLE VIII (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF SALES
(Percent)

INDUSTRY	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Primary Metals	.50%	.48%	.48%	.54%	.52%	.53%	.58%	.53%	.47%	.42%	.37%
Iron & Steel	NA	NA	NA	NA	NA	.51	.59	.56	.51	.45	.36
Nonferrous Metals	NA	NA	NA	NA	NA	.57	.57	.61	.54	.48	.47
Machinery	2.87	2.69	2.59	2.69	2.90	2.76	3.06	3.32	3.28	3.28	3.23
Electrical Machinery	9.89	9.33	9.10	9.16	9.02	9.12	8.94	9.15	8.22	8.05	7.61
Aerospace	30.32	29.37	26.00	22.05	20.90	21.88	21.30	21.77	23.68	23.48	20.25
Autos & Other Transp. Equipment	2.85	2.43	2.62	2.90	2.66	2.67	3.16	2.64	2.73	2.86	2.99
Fabricated Metals	.51	.45	.42	.48	.41	.39	.45	.51	.47	.49	.46
Instruments	4.46	4.70	4.72	4.85	5.38	5.65	5.68	5.50	5.39	5.40	5.13
Stone, Clay & Glass	.83	.79	.79	.93	.89	.93	.98	.87	.85	.83	.82
Chemicals	3.82	3.69	3.52	3.64	3.54	3.50	3.65	3.60	3.37	3.32	2.92
Paper	.45	.51	.57	.61	.65	.77	.72	.73	.61	.59	.57
Rubber	1.54	1.42	1.33	1.37	1.49	1.60	1.71	1.63	1.80	1.75	1.68
Petroleum	2.14	2.08	1.82	1.68	1.88	1.91	2.07	1.87	1.63	1.43	1.06
Food & Beverages	.20	.21	.21	.22	.21	.21	.23	.23	.23	.20	.18
Textiles	.19	.19	.26	.29	.26	.26	.26	.25	.22	.20	.21
ALL MANUFACTURING	2.95	2.81	2.80	2.84	2.79	2.75	2.74	2.63	2.49	2.35	2.17

NA - Not Available

TABLE VIII (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF SALES
(Percent)

INDUSTRY	1975	1976	1977	1978	1979	1980
Primary Metals	.46%	.62%	.58%	.53%	.51%	.60%
Iron & Steel	.51	.55	.56	.53	.56	.72
Nonferrous Metals	.77	.68	.61	.53	.46	.48
Machinery	3.33	3.30	3.17	2.99	2.90	3.27
Electrical Machinery	7.95	7.62	6.66	6.47	6.74	7.14
Aerospace	19.66	20.66	21.68	20.14	16.61	15.73
Autos & Other Transportation Equipment	2.77	2.60	2.58	2.65	3.05	4.00
Fabricated Metals	.47	.46	.43	.38	.30	.47
Instruments	5.32	5.32	5.44	5.94	6.64	6.87
Stone, Clay & Glass	.86	.86	.81	.78	.78	.88
Chemicals	3.04	2.90	2.71	2.76	2.73	2.87
Paper	.60	.65	.64	.68	.68	.68
Rubber	1.71	1.58	1.24	1.14	1.23	1.39
Petroleum	1.00	.93	.94	1.02	.85	.78
Food & Beverages	.19	.20	.22	.22	.22	.24
Textiles	.21	.22	.20	.21	.22	.24
ALL MANUFACTURING	2.26	2.21	2.13	2.11	2.12	2.31

TABLE IX

NEW PRODUCTS AS A PERCENT OF SALES FOUR YEARS AHEAD--HISTORICAL EXPECTATIONS
(Percent)

INDUSTRY	Spring 1957 For 1960	Spring 1960 For 1963	Spring 1961 For 1964	Spring 1962 For 1965	Spring 1963 For 1966	Spring 1964 For 1967	Spring 1965 For 1968	Spring 1966 For 1969	Spring 1967 For 1970
Iron & Steel	5%	10%	7%	5%	8%	9%	10%	7%	8%
Nonferrous Metals	5	7	11	9	9	13	11	9	16
Machinery	19	16	23	23	22	20	18	23	25
Electrical Machinery	18	18	16	22	22	16	23	24	26
Autos, Trucks & Parts	10	11	11	10	14	16	11	22	24
Aerospace	37	27	29	34	36	24	33	40	49
Other Transportation Equipment							19	23	12
Fabricated Metal Products	14	15	13	18	22	26	20	17	18
Instruments									
Chemicals	16	14	20	16	16	18	15	18	20
Paper	9	8	12	10	8	8	8	7	10
Rubber	5	7	7	6	8	19	14	4	7
Petroleum	2	4	5	6	4	3	4	5	7
Stone, Clay & Glass	8	9	13	13	12	14	13	17	20
Food & Beverages	7	8	12	12	7	10	9	11	12
Textiles	12	9	10	13	14	15	15	13	21
*ALL MANUFACTURING	10	12	14	14	13	15	13	15	17

* Includes miscellaneous manufacturing

TABLE IX (Continued)

NEW PRODUCTS AS A PERCENT OF SALES FOUR YEARS AHEAD--HISTORICAL EXPECTATIONS
(Percent)

INDUSTRY	Spring 1968 For 1971	Spring 1969 For 1972	Spring 1970 For 1973	Spring 1971 For 1974	Spring 1972 For 1975	Spring 1973 For 1976	Spring 1974 For 1977	Spring 1975 For 1978	Spring 1976 For 1979
Iron & Steel	7%	7%	8%	8%	10%	7%	6%	6%	10%
Nonferrous Metals	14	11	8	10	10	8	9	10	7
Machinery	22	21	20	24	24	26	27	27	25
Electrical Machinery	24	20	20	19	17	20	21	20	15
Autos, Trucks & Parts	24	17	30	31	40	40	73	40	32
Aerospace	49	51	52	31	41	18	27	18	13
Other Transporation Equipment	20	10	37	15	4	9	9	15	7
Fabricated Metal Products	24	20	19	15	18	15	17	10	16
Instruments			35	23	24	22	24	19	21
Chemicals	16	16	17	13	16	14	15	9	24
Paper & Pulp	8	12	9	19	14	14	10	7	9
Rubber	9	8	6	12	12	17	14	6	9
Petroleum	8	6	6	7	6	5	3	3	3
Stone, Clay & Glass	16	15	32	14	11	13	13	11	13
Food & Beverages	8	8	13	10	10	9	6	8	12
Textiles	20	18	14	18	15	9	17	24	15
Miscellaneous Manufacturing	12	11	15	11	19	5	13	9	12
*ALL MANUFACTURING	17	16	19	16	18	15	18	14	15

*Includes miscellaneous manufacturing

TABLE IX (Continued)

NEW PRODUCTS AS A PERCENT OF SALES FOUR YEARS AHEAD--HISTORICAL EXPECTATIONS
(Percent)

INDUSTRY	Spring 1977 For 1980	Spring 1978 For 1981	Spring 1979 For 1982	Spring 1980 For 1983	Spring 1981 For 1984
Iron & Steel	5%	9%	8%	7%	9%
Nonferrous Metals	6	10	7	4	5
Machinery	25	26	20	15	12
Electrical Machinery	16	18	21	17	17
Autos, Trucks & Parts	18	11	26	67	15
Aerospace	17	16	27	11	12
Other Transportation Equipment	17	9	9	NA	NA
Fabricated Metal Products	9	22	12	17	4
Instruments	21	24	15	31	25
Chemicals	19	12	12	10	9
Paper & Pulp	8	10	6	6	6
Rubber	8	14	16	8	11
Petroleum	3	3	2	5	3
Stone, Clay & Glass	11	10	12	10	8
Food & Beverages	11	17	10	13	17
Textiles	15	15	14	17	2
*ALL MANUFACTURING	13	14	13	15	11

*Includes miscellaneous manufacturing

TABLE X - PERCENT OF R&D GOING FOR NEW PRODUCTS, NEW PROCESSES, AND IMPROVEMENT OF EXISTING PRODUCTS - HISTORICAL

	1974			1975			1976		
	New Products	New Processes	Improving Products	New Products	New Processes	Improving Products	New Products	New Processes	Improving Products
Iron & Steel	36	18	76	15	11	74	19	30	51
Nonferrous Metals	21	49	30	24	48	28	17	52	31
Electrical Machinery	51	11	38	19	10	71	12	6	82
Machinery	40	7	53	43	11	46	25	13	62
Aerospace	24	9	67	47	8	45	41	7	52
Autos, Trucks & Parts	32	20	48	21	29	50	20	35	45
Stone, Clay & Glass	21	23	56	41	26	33	20	29	51
Fabricated Metals	24	22	54	24	26	50	19	11	70
Instruments	44	23	33	47	16	37	54	13	33
Chemicals	31	18	51	37	12	51	37	8	55
Paper	30	29	41	10	41	49	25	26	49
Rubber	25	24	51	24	15	61	20	15	65
Petroleum	23	39	38	17	45	38	18	40	42
Textiles	21	27	52	21	22	57	25	17	58
Food & Beverages	41	25	34	40	22	38	50	20	30
ALL MANUFACTURING*	36	14	50	33	14	53	29	13	58

*Includes Industries Not Shown Separately

TABLE X - PERCENT OF R&D GOING FOR NEW PRODUCTS, NEW PROCESSES, AND IMPROVEMENT OF EXISTING PRODUCTS - HISTORICAL
(Cont'd.)

	1977			1978			1979		
	New Products	New Processes	Improving Products	New Products	New Processes	Improving Products	New Products	New Processes	Improving Products
Iron & Steel	24	25	51	22	29	49	20	9	71
Nonferrous Metals	17	50	33	18	54	28	5	27	68
Electrical Machinery	9	6	85	30	34	36	32	30	38
Machinery	33	14	53	42	11	47	40	8	52
Aerospace	30	11	59	39	24	37	43	22	35
Autos, Trucks & Parts	20	38	42	27	33	40	60	19	21
Stone, Clay & Glass	29	23	48	24	34	42	37	33	30
Fabricated Metals	40	28	32	38	19	43	33	17	50
Instruments	62	13	25	55	15	30	80	11	9
Chemicals	30	20	50	26	16	58	31	23	45
Paper	23	30	47	32	19	49	25	24	51
Rubber	27	18	55	40	19	41	29	22	49
Petroleum	25	25	50	25	25	50	23	47	30
Textiles	19	26	55	18	30	52	12	39	49
Food & Beverages	38	33	29	34	20	46	20	20	60
ALL MANUFACTURING*	26	17	57	34	24	42	40	22	37

*Includes Industries Not Shown Separately

TABLE X - PERCENT OF R&D GOING FOR NEW PRODUCTS, NEW PROCESSES, AND IMPROVEMENT OF EXISTING PRODUCTS - HISTORICAL
(Cont'd.)

	1980			1981		
	New Products	New Processes	Improving Products	New Products	New Processes	Improving Products
Iron & Steel	40	16	44	56	10	34
Nonferrous Metals	5	73	22	20	46	34
Electrical Machinery	35	29	36	41	12	47
Machinery	24	5	71	47	24	29
Aerospace	51	12	37	41	9	44
Autos, Trucks & Parts	27	11	62	61	19	20
Stone, Clay & Glass	32	30	38	17	23	60
Fabricated Metals	48	19	33	50	20	30
Instruments	73	8	19	40	51	9
Chemicals	31	19	50	25	31	44
Paper	61	8	31	27	29	44
Rubber	28	29	43	32	17	51
Petroleum	13	55	32	20	71	9
Textiles	6	89	5	5	49	46
Food & Beverages	29	28	43	16	22	62
ALL MANUFACTURING	37	19	44	40	23	37